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INTRA-APERITONEAL INDWELLING CATHETER

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ABSTRACT

PURPOSE: To improve safety and compatibility with a living body, and enable long-term use by forming a part in which a catheter main body contacts with at least generation out of a material excellent in compatibility with a living body.

CONSTITUTION: An intra-aperitoneal indwelling catheter 1 is composed of a catheter main body 10 formed of a indwelling part 2 to be detained in the abdominal cavity, an extending part 4 to be extended outside of the abdominal cavity and an intermediate part 3 and a passage arranged in the catheter main body 10. A part contacting with at least a living body is processed so as to be excellent in compatibility with a living body. Therefore, it is formed by using thermoplastic fluoroelastomer excellent in compatibility with a living body as a catheter raw material. A first cuff 6 composed of dacron nonwoven fabric is arranged in a base part of an abdominal cavity part, and a second cuff 7 is also arranged in the intermediate part direction of a catheter. After it is heated in a vacuum, hot water treatment is performed, and it is also cleaned by a water-organic solvent mixed solvent, and a residue in a catheter raw material is removed, and compatibility with a living body is improved.

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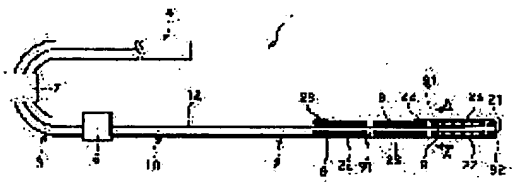
(54) INTRA-APERITONEAL INDWELLING CATHETER

(57)Abstract:
PURPOSE: To improve safety and compatibility with a living body, and enable long-term use by forming a part in which a catheter main body contacts with at least generation out of a material excellent in compatibility with a living body.
CONSTITUTION: An intra-aperitoneal indwelling catheter 1 is composed of a catheter main body 10 formed of a indwelling part 2 to be detained in the abdominal cavity, an extending part 4 to be extended outside of the abdominal cavity and an intermediate part 3 and a passage arranged in the catheter main body 10. A part contacting with at least a living body is processed so as to be excellent in compatibility with a living body. Therefore, it is formed by using thermoplastic fluoroelastomer excellent in compatibility with a living body as a catheter raw material. A first cuff 6 composed of dacron nonwoven fabric is arranged in a base part of an abdominal cavity part, and a second cuff 7 is also arranged in the intermediate part direction of a catheter. After it is heated in a vacuum, hot water treatment is performed, and it is also cleaned by a water-organic solvent mixed solvent, and a residue in a catheter raw material is removed, and compatibility with a living body is improved.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] An intraperitoneal indwelling catheter which is an intraperitoneal indwelling catheter which has a main part of a catheter which consists of the detention section detained in intraperitoneal, the extension section which extends out of an abdominal wall, and this detention section and pars intermedia between these extension sections, and a path established in this main part of a catheter, and is characterized by forming a portion of a main part of a catheter which touches a living body at least by member which is excellent in biocompatibility.
[Claim 2] An intraperitoneal indwelling catheter according to claim 1 whose member which is excellent in said biocompatibility is a fluorine elastomer.
[Claim 3] An intraperitoneal indwelling catheter according to claim 1 from which a product which a member which is excellent in said biocompatibility carried out radiation-induced crosslinking of the thermoplastic fluorine elastomer, and produced according to this bridge formation is removed.
[Claim 4] An intraperitoneal indwelling catheter according to claim 3 whose removal methods of a product by said radiation-induced crosslinking are vacuum heating, washing with a water-organic solvent mixed solvent and/or hot water processings, or such combination.
[Claim 5] An intraperitoneal indwelling catheter according to claim 3 whose removal methods of a product by said radiation-induced crosslinking are vacuum heating and/or hot water processing.
[Claim 6] An intraperitoneal indwelling catheter according to claim 3 which a removal method of a product by said radiation-induced crosslinking carries out vacuum heating, carries out once [at least] combining the post heating water treatment and washing with a water-organic solvent mixed solvent, and performs the post heating water treatment.
[Claim 7] An intraperitoneal indwelling catheter according to claim 4 or 6 which is the mixed solvent of at least one organic solvent and water which are chosen from a group which said water-organic solvent mixed solvent becomes from an acetonitrile, an acetone, a tetrahydrofuran, dioxane, dimethyl sulfoxide, and ethanol.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the intraperitoneal indwelling catheter used in order to detain in intraperitoneal and to carry out notes discharge of the dialysing fluid mainly in a peritoneal dialysis method. It is related with the intraperitoneal indwelling catheter which was excellent in biocompatibility as medical-application polymeric materials especially.
[0002]
[Description of the Prior Art] Dialysis is performed for the purpose of removal of urine poison, such as water which mainly executed a part of kidney function by proxy, and was accumulated in the inside of the body, and a urea, a creatinine. And in many cases, the therapy by the hemodialysis therapy is performed, but since it is a therapy under the monitor of special equipment, the burden which is obliged to two - three going to hospital regularly per week, and one therapy also requires for 4 - 5 hours, a patient, or its family is large, and serves as big hindrance of social rehabilitation of a patient.
[0003] On the other hand, a peritoneal dialysis therapy makes the time constraint to a patient mitigate, and since it is a cure which made social rehabilitation possible, the number of patients which undergoes this therapy is increasing it. In this peritoneal dialysis therapy, dialysing fluid (dialysis perfusate) is poured in into the peritoneum, and after carrying out fixed time amount progress, the technique of discharging the effluent of dialysing fluid out of the abdominal cavity is made. And impregnation of such dialysing fluid and discharge of an effluent are performed by the intraperitoneal indwelling catheter currently detained in intraperitoneal, and the dialysing fluid switching system connected to this catheter.
[0004] Conventionally, the cuff member which an intraperitoneal indwelling catheter consists of a path of the main part of a catheter which consists of the detention section detained in intraperitoneal, the extension section which extends out of an abdominal wall, and the detention section and the pars intermedia between the extension sections, and the main part of a catheter, and becomes two by the side of the detention section of pars intermedia and the extension section from the nonwoven fabric made from dacron etc. was prepared. And suture immobilization of the 1st cuff prepared in the detention section side of pars intermedia was carried out at the peritoneum, the 2nd cuff prepared in the extension section side was located in subcutaneous tissue, and the catheter was transplanted to the patient. In this case, in order to prevent that the moisture containing bacteria, such as sweat and bacteria, invades from the endermic section of the catheter in the dialysing fluid impregnation and exhaust port, and abdominal wall of the extension section of a catheter, dialysing fluid impregnation and the exhaust port of the extension section needed to be placed upside down, and the patient needed to be made to transplant a catheter.
[0005] However, since the above-mentioned catheter was formed in the shape of a straight line, it was difficult the catheter to place dialysing fluid impregnation and an exhaust port upside down, and

to detain a catheter by the recuperability of a catheter. Moreover, it was also difficult to proliferate a body tissue in a cuff member and to fix a catheter by this. Furthermore, the so-called down growth to which epidermis enters inside along with a catheter since a body tissue carries out foreign matter recognition of the catheter and a body tissue does not stick with a catheter when a catheter is transplanted to a patient (Down Growth) There was a problem that it was generated. if down growth becomes deep, disinfection will not be prudent and the bacterial route of infection will be formed — ******** — skin inflammations — as a result, it may cause to peritonitis and has been a problem.

[0006] Then, the swan neck mold catheter ("Swan Neck" is the registered trademark of ACCURATE SURGICAL INSTRUMENT) which carried out crookedness formation of the pars intermedia (hypodermically tunnel section) of a catheter beforehand inverted-L-shaped is developed and used widely. This intraperitoneal indwelling catheter made it possible to place dialysing fluid impregnation and the exhaust port of the extension section upside down, and to transplant it to a patient. However, also in this catheter, the cuff member which consists of a nonwoven fabric made from dacron etc. as the 2nd cuff was used, and when a catheter is transplanted to a patient, it predetermined-length-separated from the endermic section of a catheter, and is arranged. For this reason, it is difficult to cluster the body tissue near the endermic section of a catheter in the perimeter of a catheter, and there was a possibility that down growth might become deep. For this reason, it was difficult to prevent completely that bacteria trespass upon the inside of the body from the endermic section of the catheter in an abdominal wall.

[0007] On the other hand, although silicone is generally used as medical-application polymeric materials, such as a catheter, when it embeds in the living body over a long period of time, a close-up of the problem and the problem that a lipid in the living body decomposes further on clinical [based on the fiber nature capsule made into the perimeter] is taken recently, and they are no longer used as a long-term embedding material. dialysis meeting magazine 26(1):43- although silicone is used also in the intraperitoneal indwelling catheter as indicated in 47 and 1993, in long-term use, white upheaval will be accepted in a catheter in CAPD history five years, or a pinhole is generated and the problem from which the qualitative gestalt-change of a liquid spill being seen etc. arises is pointed out.

[0008] When it embeds to a living body with the material excellent in chemical resistance, solvent resistance, and oilproof, a fluororesin shows stability over a long period of time, and there is little decomposition. Furthermore, use is expected as a medical high polymer with the feature that it can carry out fabrication like common thermoplastics although a thermoplastic fluorine elastomer shows rubber elasticity in ordinary temperature. However, in order to raise stress-proof destruction nature and an elevated-temperature property, it is necessary to perform bridge formation by radiation. Bridge formation by this radiation is performed from that presentation using generation of double association by the desorption of HF (hydrogen fluoride). For this reason, when generated HF remains in a thermoplastic fluorine elastomer and uses as a medical supply, the effect on safety and a living body poses a problem.

[0009]

[Problem(s) to be Solved by the Invention] When the purpose of this invention carries out radiation-induced crosslinking of the intraperitoneal indwelling catheter which consists of members which are excellent in biocompatibility, such as a fluorine elastomer, and the catheter which consists of a thermoplastic fluorine elastomer especially, it removes HF which remains in an elastomer, safety is highly excellent in biocompatibility, and it is to offer the intraperitoneal indwelling catheter in which prolonged use is possible.

[0010]

[Means for Solving the Problem] The above-mentioned technical problem washes as follows a thermoplastic fluorine elastomer by which radiation-induced crosslinking was carried out, and is solved by making the residue in a material remove.

[0011] a thermoplastic fluorine elastomer which performed radiation-induced crosslinking — vacuum heating — carrying out — and — or a water-organic solvent mixed solvent — washing — and — or hot water processing is carried out. bridge formation specifically according to gamma irradiation under deoxidation — it is a mixing ratio 95 / 5 - 5/95 about a thermoplastic fluorine elastomer which constructed the bridge by 0.5 - 5Mrad preferably, and after a water-organic solvent mixed solvent of the amount of five to 30 times performing reflux for 50-100 degrees C, 30 minutes - 4 hours, and a mixed solvent's washing several times and performing a vacuum drying, water of an amount performs autoclave processing five to 20 times for 50-130 degrees C, 10 minutes - 2 hours. this actuation of a series of — 1 time — or it carries out two or more times.
[0012] An organic solvent used here has an acetonitrile, an acetone, a tetrahydrofuran, dioxane, dimethyl sulfoxide, and desirable ethanol.
[0013] A catheter of this invention does not ask the configuration or structure that what is necessary is just what is processed so that a portion which touches the living body at least may explain below and it may excel in biocompatibility. A main part of a catheter is formed by fluorine elastomer whose catheter of this invention is a fluororesin which has rubber elasticity preferably, especially thermoplastic fluorine elastomer. A thermoplastic fluorine elastomer is also called a thermoplastic fluororesin, it is developed so that elasticity may be given to thermoplastics containing fluorine, and a product is built with thermoplastics by the fabricating method with sufficient production efficiency, such as injection molding and extrusion molding. Specifically, trade name DAIERU thermoplastic (Daikin Industries [, LTD.], LTD. make) etc. is mentioned. This invention fabricates a catheter of a well-known configuration of a configuration later mentioned using a thermoplastic fluorine elastomer, or others. Then, a bridge is constructed by irradiating radiation in order to raise stress-proof destruction nature and an elevated-temperature property. Bridge formation irradiates radiation by exposure 0.5 - 5Mrad by vacuum lower deoxygenation under an inert atmosphere. HF ****s by this exposure, double association generates, and stress-proof destruction nature and an elevated-temperature property improve. However, HF from which it was desorbed will remain in an elastomer. In this invention, independent or HF which combined and generated 1 time or a multiple-times line in an elastomer is removed for the following processings.
[0014] 1) Process a catheter at 40-150 degrees C for 30 minutes - 4 hours under a vacuum of the vacuum heating degree of vacuum 1 - 76cmHg. If it processes on condition that this range, a certain amount of deHF will become possible, without using a washing solvent. Moreover, if a washing production process is further performed following vacuum heating, a production process and time amount can be shortened. When combining a production process, it is desirable to perform vacuum heating first.
[0015] 2) Process a hot water processing catheter with 50-100-degree C hot water for 10 minutes to 2 hours. At this time, that [amount's of water] of **** for the amounts of five to 20 times of thermoplastic fluorine elastomer weight is desirable. Churning etc. may be performed although hot water processing is performed by being immersed in hot water. When combining a production process, a production process washed with a water-organic solvent mixed solvent which will continue if it carries out before a production process washed with a water-organic solvent mixed solvent can be performed efficiently.
[0016] 3) A water-organic solvent mixed solvent washes.
An acetonitrile, an acetone, a tetrahydrofuran, dioxane, dimethyl sulfoxide, ethanol, or such mixture of an organic solvent to be used are desirable. As for a mixing ratio of water and an organic solvent, it is desirable that it is 95 / 5 - 5/95. This water-organic solvent mixed solvent has that desirable of **** for the amounts of five to 30 times of weight of a thermoplastic fluorine elastomer. That is because swelling of the thermoplastic fluorine elastomer is carried out with a water-organic solvent mixed solvent and HF can be removed. An organic solvent is removable if hot water processing is performed after this production process. It is desirable that washing temperature in a water-organic solvent mixed solvent is 50-100 degrees C, and washing time amount is 30 minutes - 4 hours. As

for washing, it is desirable to process, to clean a catheter ultrasonically or to spray it as mechanical agitation and a jet blast into a mixed solvent, etc. [immerse]
[0017] As for 1 vacuum heating explained above, 2 hot-water processing, and processing of washing with a 3 water-organic solvent mixed solvent, it is desirable to carry out by combining as follows. It is desirable to perform it 1 to 30 times, using this combination as 1 time.
Combination of washing and 2 hot-water processing with a vacuum heating and 1 vacuum heating +3 water-organic solvent mixed solvent 1) Multiple times, 1) Vacuum heating +2 hot-water processing and 1 vacuum heating +2 hot-water processing Multiple times, 1) With a vacuum heating +2 hot-water processing +3 water-organic solvent mixed solvent, washing +2 hot-water processing, 1) Vacuum heating +2 hot-water processing with a multiple-times +3 water-organic solvent mixed solvent Washing +2 hot-water processing, 1) Combination of washing and 2 hot-water processing with a vacuum heating +2 hot-water processing +3 water-organic solvent mixed solvent Multiple times, 1) What does not perform 1 vacuum heat-treatment which begins combination of washing and 2 hot-water processing for vacuum heating +2 hot-water processing by washing and these combination processings with a multiple-times +3 water-organic solvent mixed solvent at multiple times and a 1 vacuum heating +3 water-organic solvent mixed solvent.
[0018] Hereafter, with reference to an accompanying drawing, an intraperitoneal indwelling catheter concerning a suitable example of this invention is explained concretely. Drawing 1 is the whole intraperitoneal indwelling catheter side elevation showing one example with suitable this invention, and drawing 2 is an A-A line cross section in drawing 1 .
[0019] In a peritoneal dialysis method, the intraperitoneal indwelling catheter 1 of this invention is used as exchange passage of the dialysing fluid, in case technique of discharging an effluent of dialysing fluid out of the abdominal cavity is performed after pouring dialysing fluid into intraperitoneal and carrying out fixed time amount progress. Namely, while making intraperitoneal [of a patient] penetrate an abdominal wall, inserting a point of this intraperitoneal indwelling catheter 1 and detaining a point of this intraperitoneal indwelling catheter 1 in intraperitoneal, maintaining the condition of having made the end face section of the intraperitoneal indwelling catheter 1 extending out of an abdominal wall, a patient leads everyday life and exchanges dialysing fluid through this intraperitoneal indwelling catheter 1 for every fixed time amount.
[0020] This intraperitoneal indwelling catheter 1 has the main part 10 of a catheter which consists of the detention section 2 detained in intraperitoneal, the extension section 4 which extends out of an abdominal wall, and the detention section 2 and the pars intermedia 3 between the extension sections 4, and the path 11 established in the main part 10 of a catheter, and it is processed so that a portion which touches that living body at least may be excellent in biocompatibility.
[0021] The main part 10 of a catheter is a tubular object, a tip side inserted in intraperitoneal serves as the detention section 2, and a end face side which extends out of an abdominal wall serves as the extension section 4. Moreover, it is pars intermedia 3 between the detention section 2 and the extension section 4. And pars intermedia 3 forms a hypodermically tunnel between intraperitoneal and the outside of an abdominal wall by path of the main part 10 of a catheter.
[0022] And it has the slot 23 which the opening 21 of a path 11 is formed at a tip of the detention section 2 towards shaft orientations of the main part 10 of a catheter, and met an outside surface of the detention section 2 at shaft orientations, and the side hole 22 drilled in a pars basilaris ossis occipitalis of a slot 23. As shown in drawing 2 , in a cross-sectional view, this side hole 22 is formed in a hoop direction by four regular intervals, and is arranged at equal intervals on a straight line parallel to a shaft of the main part 10 of a catheter. Dialysing fluid is exchanged through a opening 21 and two or more side holes 22.
[0023] Moreover, of formation of a slot 23, it becomes heavy-gage between a slot 23 and a slot 23, and heights 9 are formed. Thus, since area with an intraperitoneal wall which contacts becomes large, two or more heights 9 which it comes to form have little effect which a pressure given when an intraperitoneal wall is contacted is distributed, and it has on the inside of the body. Moreover, it

has projected from a tip of the detention section 2, the tip 92 is formed in the shape of a circle, and the tip 92 of heights 9 serves as a configuration which contacts an intraperitoneal wall and the Douglas ** and is not damaged. By forming this tip 92, when the detention section 2 contacts the Douglas ** located in intraperitoneal lowest place, it is secured, without blockading the opening 21 of a path (henceforth a "lumen") 11.

[0024] In addition, there are a method of forming a heavy-gage shell by extrusion molding, deleting an outside surface after that as a method of forming such heavy-gage and broad heights 9, for example, and forming a slot 23, a method using a die which forms heights 9 at the time of extrusion molding, etc. After fabricating a tube with which heights 9 were formed over an overall length at the time of extrusion molding when heights 9 were formed by method using a die which forms heights 9, a method of making the slot 23 which was able to do only predetermined length by formation of heights 9 buried, or shaving off heights 9 only for predetermined length is. Moreover, even when heights 9 are formed by which method, improvement in reinforcement can be aimed at by forming the connection section 91 which filled a slot 23 at intervals of predetermined, and was formed, and connecting the adjoining heights 9.

[0025] Moreover, although the detention section 2 (or tip of the detention section 2) may be formed independently and you may make it connect with pars intermedia 3 and the extension section 4, the detention section 2, pars intermedia 3, and an extension 4 may be formed as a main part 10 of a catheter in one.

[0026] On the other hand, a connector (not shown) etc. is prepared in a end face of the extension section 4, and a peritoneal dialysis system which comes to connect a dialysing fluid bag, an effluent bag, etc. by tube is connected to it through this connector etc.

[0027] Pars intermedia (henceforth the "hypodermically tunnel section") 3 curves in the shape of a loop, is formed, and is making a U character configuration (swan neck configuration). And near loop top-most vertices, the 2nd cuff 7 is being fixed to the detention section 2 side of the hypodermically tunnel section 3 for the 1st cuff 6 by silicone system adhesives etc., respectively.

[0028] And the 1st cuff 6 and 2nd cuff 7 are formed in the shape of a pipe with a nonwoven fabric made from dacron, by carrying out suture immobilization of these cuffs 6 and 7 at a body tissue, fibroblast which is a body tissue increases in a cuff 6 and 7, and the main part 10 of a catheter is detained in a fixed location.

[0029] Moreover, it is desirable to adhere the marker 12 of the main part 10 of a catheter which becomes the detention section 2 at least from a radiopacity material to laying under the ground or the inside-and-outside surface. Thereby, a location of the main part 10 of a catheter can be checked under radioscopy at the time of catheter transplantation. A configuration of this marker 12 may be established [like illustration] over the hypodermically tunnel section 3 from the detention section 2 as a line, and may be established over an overall length of the main part 10 of a catheter. Furthermore, it may apply to the hypodermically tunnel section 3 from the detention section 2, a position may be made dotted, and you may prepare. As a radiopacity material which constitutes a marker 12, a tungsten, a barium sulfate, gold, platinum, or those alloys are mentioned, for example.

[0030] Moreover, it is possible by preparing two or more fins in the lumen 11 of the main part 10 of a catheter over the hypodermically tunnel section 3 from the detention section 2 at least to prevent that a lumen 11 crushes and blockades by the inside of an abdominal wall or intraperitoneal intraperitoneal and within an abdominal wall at the time of catheter transplantation and exchange of dialysing fluid.

[0031] Here, although an overall length of the main part 10 of a catheter changes with cases, about 250-600mm, it is about 350-500mm more preferably about 300-550mm, among these the hypodermically tunnel section 3 is about 100-150mm, and it is the detention section 2 is about 150-200mm, and preferably desirable [the extension section 4] that it is about 100-150mm. Furthermore, the heights 9 formation section of the detention section 2 is about 110-60mm, and, as for the 1st and 2nd cuffs 6 and 7, it is desirable that it is about 5.0-15mm. Moreover, protrusion

length at the tip 92 of heights is about 2.0-10mm preferably about 1.0-20mm.
[0032] And a bore of the main part 10 of a catheter is about 2.0-3.0mm preferably about 1.0-3.5mm, and specifically, thickness of the main part 10 of a catheter is about 2.0-2.5mm preferably about 1.0-3.0mm in a heavy-gage portion, although only the detention section 2 may form only the heights 9 formation section of the detention section 2 heavy-gage and the same thickness is sufficient as it over an overall length. And height (depth of a slot 23) of the heights 9 formed in the detention section 2 is about 1.0-1.3mm preferably about 0.5-1.5mm.
[0033] Moreover, as for the number of heights 9 or slots 23, it is desirable not only four but to be three or five or more from one, and for it to be decided in accordance with an outer diameter of the main part 10 of a catheter etc., and to set up height of heights 9 according to the number of heights 9. Furthermore, what is necessary is just to form the connection section 91 if needed with the quality of the material, thickness, etc. which form the main part 10 of a catheter. Moreover, the about 6-20 number per number of the fang furrows 23 also by the number of slots 23 of side holes 22 is about 8-16 preferably.
[0034] A thing of the intraperitoneal indwelling catheter 1 explained above for which hydrophilization processing is performed to an outside surface at least over the hypodermically tunnel section 3 from the detention section 2 is desirable, and a method of coating hydrophilic polymer, such as Pori (2-hydroxyethyl methacrylate), polyhydroxy ethyl acrylate, hydroxypropylcellulose, a methyl-vinyl-ether maleic-anhydride copolymer, a polyethylene glycol, polyacrylamide, and a polyvinyl pyrrolidone, as such hydrophilization processing is mentioned.
[0035] Since insertion resistance when inserting a catheter in intraperitoneal can be mitigated and time amount of catheter transplant surgery is shortened when such processing is performed, a patient's burden is reduced in case a catheter is transplanted to a patient. Moreover, damage on membrane is lessened more and there is also depressor effect of organization concrescence.
[0036] Next, a condition when transplanting the intraperitoneal indwelling catheter 1 concerning a suitable example of this invention to a patient is explained concretely. In addition, drawing 3 is the fragmentary sectional view showing the condition of having transplanted an intraperitoneal indwelling catheter concerning an example of this invention to a patient's abdominal wall.
[0037] the hypodermically tunnel section 3 of the intraperitoneal indwelling catheter 1 penetrates and transplants an abdominal wall 100, as shown in drawing 3 -- having -- **** -- the lumen 11 of the main part 10 of a catheter -- intraperitoneal -- a hypodermically tunnel is formed between 120 and 110 outside an abdominal wall. It is exchanged in dialysing fluid through this hypodermically tunnel. moreover, a tip side of the hypodermically tunnel section 3 formed by curving in the shape of a loop -- the peritoneum 101 -- penetrating -- intraperitoneal -- it is detained in 120, and a end face side of the hypodermically tunnel section 3 penetrated epidermis 105, and has extended to 110 outside an abdominal wall. and intraperitoneal -- a connector is connected to a end face of the extension section 4 which a tip of the detention section 2 detained in 120 was located in a pouch of Douglas, and extended to 110 outside an abdominal wall.
[0038] The 1st cuff 6 prepared in the detention section 2 side of the hypodermically tunnel section 3 is located in a pars basilaris ossis occipitalis of the tunica-muscularis organization 102, and suture immobilization is carried out at the peritoneum 101. The main part 10 of a catheter is fixed to an abdominal wall 100 by this 1st cuff 6, and the detention section 2 is detained in a fixed location. Moreover, this 1st cuff 6 prevents that dialysing fluid leaks out out of the abdominal cavity 120, when dialysing fluid is injected into the abdominal cavity 120.
[0039] The 2nd cuff 7 prepared near the loop top-most vertices of the hypodermically tunnel section 3 is located in a pars basilaris ossis occipitalis of subcutaneous tissue 104, and suture immobilization is carried out at the recti-abdominis fascia 103. Dialysing fluid impregnation and an exhaust port are placed upside down, and the hypodermically tunnel section 3 is fixed to a body tissue by this 2nd cuff 7.
[0040]

[Example] Hereafter, an example explains this invention still more concretely.
[0041] (Example 1) The peritoneal lavage dialysis catheter using the thermoplastic fluorine elastomer excellent in the biocompatibility shown in drawing 1 as a catheter material was used. The overall length of a catheter is a tubular object with 435mm, a bore [of 2.5mm], and an outer diameter of 4.7mm, and the endocyst of Rhine of radiopacity is carried out in the thick direction of a major axis of the tubular object. One side of a end face was detained in intraperitoneal, and formed four slots in the side of 85mm of the tip portion along the direction of a major axis. Furthermore, a notes effluent hole with a diameter of 0.5mm sets a predetermined gap to this Mizouchi, and is drilled. The 1st cuff which consists of a dacron nonwoven fabric with a width of face of 1cm is prepared in the periphery of the catheter in the base of an abdominal part, and a catheter is fixed. The 2nd becoming cuff from a dacron nonwoven fabric with a width of face of 1cm is prepared in the periphery of a catheter, and the end face of another side of a catheter extends outside of the body so that the hypodermically tunnel section may be prepared in the direction of catheter pars intermedia and a catheter may furthermore be fixed to a recti-abdominis fascia from the 1st cuff. The removal method of the residue in the catheter material for raising biocompatibility here is explained. After constructing a bridge by carrying out a gamma ray 3Mrad exposure under deoxidation of the catheter which consists of a thermoplastic fluorine elastomer (the Daikin Industries, LTD. make, DAIERU thermoplastic T-530), in the mixed solvent which consists of acetonitrile-water 1:1 of the amount of 20 times, it flowed back for 4 hours and 70 degrees C of vacuum dryings were performed. 67 moreml distilled water performed 121 degrees C and 60-minute autoclave processing (AC extract). The count which considers actuation which flows back and carries out an after [a vacuum drying] AC extract in this 4-hour mixed solvent as one actuation, and is shown in a table 1 was performed a total of 13 times, respectively.
[0042] (Example 1 of a comparison) The sheet with a thickness of 0.2mm was produced for the thermoplastic fluorine elastomer (the Daikin Industries, LTD. make, DAIERU thermoplastic T-530) at 240 degrees C.
[0043] (Example 2 of a comparison) At 240 degrees C, the sheet with a thickness of 0.2mm was produced and the bottom gamma ray of deoxidation 3Mrad exposure of the thermoplastic fluorine elastomer (the Daikin Industries, LTD. make, DAIERU thermoplastic T-530) was carried out.
[0044] (Example 3 of a comparison) The sheet with a thickness of 0.2mm was produced for the silicone elastomer (Dow Corning make silastic Q7-4750) at 110 degrees C.
[0045] Fluoride ion concentration was measured with the lanthanum-alizarin complexon absorptiometry about the autoclave extract for every count of obtained in evaluation trial 1 example 1 and the example of a comparison, and the quantum of HF was performed. A result is shown in a table 1.
[0046] When the thing non-constructed a bridge is compared with the thing which performed gamma ray bridge formation so that clearly from the result shown in a table 1, what performed gamma ray bridge formation is understood that a lot of HF is generating. Whenever the count of washing of bridge formation thermoplastic elastomer obtained according to the example 1 concerning the washing method of this invention increased, the elution of HF was decreasing and it was set to the thing non-constructed a bridge and this level in 13 counts of washing.
[0047] According to evaluation trial 2 example 1, the elution volume of HF embedded 10mm and 0.2mm piece in sample phi thickness which were obtained in the bridge formation thermoplasticity fluorine elastomer used as the thing non-constructed a bridge and this level and the example 1 of a comparison, the example 2 of a comparison, and the example 3 of a comparison mouse intraperitoneal, and was searched on the pathology histology target about change of a circumference organization 12 weeks after. A result is shown in a table 2. Intense peritonitis was induced in the example 3 of a comparison. Although just peritonitis was not shown by the example 1 of a comparison, the Histiocyte infiltration which capsula-fibrosa (capsule) formation is accepted in the perimeter of a sample, and serves as an index of inflammation had followed. In the example 2 of

a comparison, the same capsule formation and Histiocyte infiltration were accepted in altitude from the example 1 of a comparison. It compares with them, and is covered by the cell of the mesothelial cell who has covered about [that capsula-fibrosa formation or Histiocyte infiltration of peritonitis or the perimeter of a sample are not induced], or many intraperitoneal organ surfaces with the example 1, and the height of the biocompatibility of the material was suggested strongly.
[0048] Improvement in the stress-proof destruction nature by the radiation-induced crosslinking of an evaluation trial 3 thermoplasticity fluorine elastomer and an elevated-temperature property is shown.
[0049] The tube of a thermoplastic fluorine elastomer (bore phi2.5mm and outer-diameter phi4.7mm), a gamma ray 3Mrad exposure thermoplasticity fluorine elastomer, and silicone was curved at 30 degrees, and it was immersed in the 50-degree C iso gin solution in the condition. The 50th day of immersion and a silicone tube became opaque [a tube] with iso gin, and the upheaval object was further seen on the tube surface in part. On the other hand, transparency is maintained and, as for the gamma irradiation thermoplasticity fluorine elastomer, the drug-induced one-proof of this material was shown. moreover, the stress-proof destruction nature according [although cutting of a tube was seen about the gamma ray non-glared thing on the 1st day of immersion, cutting, a crack, etc. are not seen about the tube of a gamma ray 3Mrad exposure, but] to gamma irradiation and warming — improvement in the physical properties at the time was checked.
[0050]
Table 1 ———————————— Fluoride ion concentration (ppm) ———————————— example 1 of a comparison Example 2 of a comparison Example 1 ———————————— AC extract 0.08 5.55 After [4hr washing] AC extract x 1 1.88 After [4hr washing] AC extract x 3 0.65 After [4hr washing] AC extract x 5 0.33 After [4hr washing] AC extract x 7 0.25 After [4hr washing] AC extract x 9 0.15 After 4hr washing, AC extract x11 0.10 It is AC extract x13 after 4hr washing. 0.08 ———————————— [0051] (Example 2) It turned out that the same effect is acquired by the small count of washing, and time amount by degree of vacuum 76cmHg compared with an example 1 when 120 degrees C of the same processings as an example 1 are performed for 2 hours, after carrying out vacuum heating.
[0052]
table 2 ———————————— Peritonitis SCORE the sample perimeter To a sample [or] Capsule formation Cell ———————— ———————— example 1 which has permeated - - Mesothelial cell (+)
Example 1 of a comparison - + Histiocyte (+)
Example 2 of a comparison - ++ Histiocyte (++)
Example 3 of a comparison +++ - Histiocyte (+)
———————————— [0053]
[Effect of the Invention] There is little deterioration explained above according to drugs etc. by this invention like, and improvement in the stress-proof destruction nature by radiation-induced crosslinking and an elevated-temperature property and the intraperitoneal indwelling catheter whose biocompatibility improved by having washed further are obtained.

[Translation done.]

* NOTICES *

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3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The whole intraperitoneal indwelling catheter side elevation concerning the example of this invention.
[Drawing 2] The A-A line cross section in drawing 1 .
[Drawing 3] The fragmentary sectional view showing the condition of having transplanted the intraperitoneal indwelling catheter concerning the example of this invention to a patient's abdominal wall.
[Description of Notations]
1 Intraperitoneal Indwelling Catheter
2 Detention Section
3 Hypodermically Tunnel Section
4 Extension Section
6 1st Cuff
7 2nd Cuff
9 Heights
10 Main Part of Catheter
11 Path
12 Marker
21 Opening
22 Side Hole
23 Slot
91 Connection Section
92 Tip of Heights
100 Abdominal Wall
101 Peritoneum
102 Tunica-Muscularis Organization
103 Recti-Abdominis Fascia
104 Subcutaneous Tissue
110 Outside of Abdominal Wall
120 Abdominal Cavity
150 Down Growth

[Translation done.]

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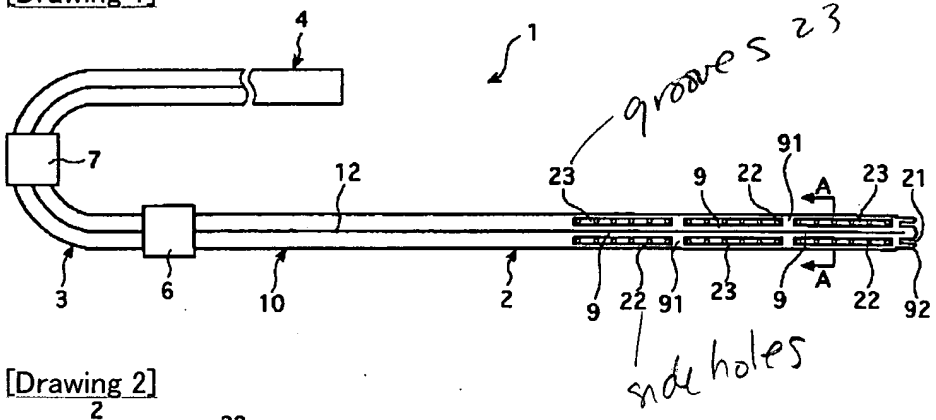
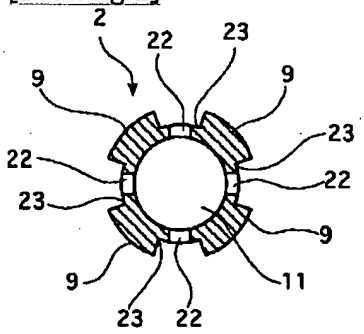
DRAWINGS

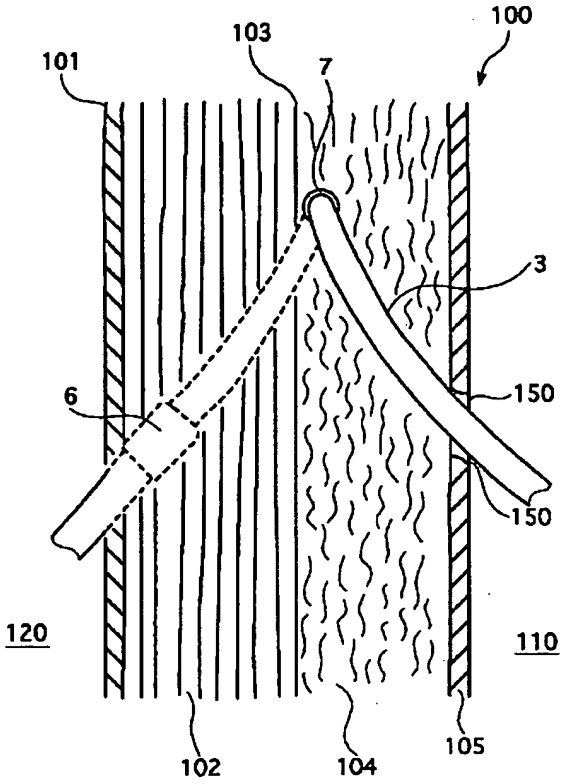
[Drawing 1]



[Drawing 2]



[Drawing 3]



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最終頁に続く

(54)【発明の名称】　腹腔内留置カテーテル

(57)【要約】
【目的】生体適合性に優れる腹腔内留置カテーテルの提供。
【構成】フッ素エラストマー等の生体適合性に優れる部材で形成された腹腔内留置カテーテル、特に、熱可塑性フッ素エラストマーよりなるカテーテルを放射線架橋し、該架橋により生じた生成物を真空加熱、溶媒洗浄、熱水処理を行って除去した腹腔内留置カテーテル。

【特許請求の範囲】

【請求項１】腹腔内に留置される留置部と、腹壁外に延出される延出部と、該留置部と該延出部の間の中間部とからなるカテーテル本体と、該カテーテル本体に設けられた通路とを有する腹腔内留置カテーテルであって、カテーテル本体の少なくとも生体と接する部分が生体適合性に優れる部材で形成されていることを特徴とする腹腔内留置カテーテル。

【請求項２】前記生体適合性に優れる部材が、フッ素エラストマーである請求項１記載の腹腔内留置カテーテル。

【請求項３】前記生体適合性に優れる部材が、熱可塑性フッ素エラストマーを放射線架橋し、該架橋により生じた生成物を除去したものである請求項１記載の腹腔内留置カテーテル。

【請求項４】前記放射線架橋による生成物の除去方法が真空加熱および／または水－有機溶媒混合溶媒での洗浄および／または熱水処理、またはこれらの組み合わせである請求項３記載の腹腔内留置カテーテル。

【請求項５】前記放射線架橋による生成物の除去方法が真空加熱、および／または熱水処理である請求項３記載の腹腔内留置カテーテル。

【請求項６】前記放射線架橋による生成物の除去方法が真空加熱し、その後熱水処理と水－有機溶媒混合溶媒での洗浄を組み合わせて少なくとも１回行ない、その後熱水処理を行う請求項３記載の腹腔内留置カテーテル。

【請求項７】前記水－有機溶媒混合溶媒が、アセトニトリル、アセトン、テトラヒドロフラン、ジオキサン、ジメチルスルホキシドおよびエタノールからなる群から選ばれる少なくとも１つの有機溶媒と水との混合溶媒である請求項４または６に記載の腹腔内留置カテーテル。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、主として、腹膜透析法において、腹腔内に留置して透析液を注排出するために用いる腹腔内留置カテーテルに関する。特に、医療用高分子材料として生体適合性の優れた腹腔内留置カテーテルに関するものである。

【０００２】

【従来の技術】透析療法は、主として腎機能の一部を代行して体内に蓄積された水や尿素、クレアチニン等の尿毒物質の除去を目的として行われる。そして、多くの場合に血液透析療法による治療が行われているが、特別な装置の監視下での治療であるため、週２～３回の通院を余儀なくされ、また、１回の治療も４～５時間と患者あるいはその家族にかかる負担が大きく、患者の社会復帰の大きな妨げとなっている。

【０００３】一方、腹膜透析療法は、患者に対する時間的拘束を軽減させ、社会復帰を可能とした治療法であるため、この治療を受ける患者数が増加している。この腹膜透析療法においては、透析液（透析排液）を腹膜内に注入し、一定時間経過した後に透析液の排液を腹腔外に排出するといった手技がなされる。そして、このような透析液の注入、排液の排出は、腹腔内に留置されている腹腔内留置カテーテルと、このカテーテルに接続される透析液交換システムとにより行われる。

【０００４】従来、腹腔内留置カテーテルは、腹腔内に留置される留置部と、腹壁外に延出される延出部と、留置部と延出部の間の中間部とからなるカテーテル本体と、カテーテル本体の通路とからなり、中間部の留置部側と延出部側の２ヶ所にダクロン製不織布などからなるカフ部材が設けられていた。そして、中間部の留置部側に設けられた第１のカフを腹膜に縫合固定し、延出部側に設けられた第２のカフを皮下組織に位置させて、患者にカテーテルを移植していた。この際には、汗やバクテリアなどの細菌を含有する水分がカテーテルの延出部の透析液注入・排出口や腹壁におけるカテーテルの経皮部から侵入することを防止するため、延出部の透析液注入・排出口を下向きにして患者にカテーテルを移植させる必要があった。

【０００５】しかしながら、上述のカテーテルは、直線状に形成されていたため、カテーテルの回復力により、透析液注入・排出口を下向きにしてカテーテルを留置することは困難であった。また、このことにより、生体組織をカフ部材内に増殖させてカテーテルを固定することも困難であった。さらに、患者にカテーテルを移植した際に、生体組織がカテーテルを異物認識し、生体組織がカテーテルと密着しないため、表皮がカテーテルに沿って内側に入り込む、いわゆるダウングロース（Down Growth）が生じるという問題があった。ダウングロースが深くなると、消毒が行き届かず、細菌の感染経路を形成することとなり、皮膚の炎症やひいては腹膜炎まで引き起こす可能性があり問題となっている。

【０００６】そこで、カテーテルの中間部（皮下トンネル部）を予め逆Ｕ字状に屈曲形成したスワンネック型カテーテル（「Swan Neck」は、ACCURATE SURGICAL INSTRUMENT社の登録商標）が開発され、汎用されている。この腹腔内留置カテーテルは、延出部の透析液注入・排出口を下向きにして患者に移植することを可能とした。しかし、このカテーテルにおいても、第２のカフとしてダクロン製不織布などからなるカフ部材を用いており、カテーテルを患者に移植したときにカテーテルの経皮部から所定長離れて配置されていた。このため、カテーテルの経皮部付近の生体組織をカテーテルの周囲に密集させることは困難であり、ダウングロースが深くなっていく恐れがあった。このため、腹壁におけるカテーテルの経皮部から細菌が体内に侵入することを完全に防止することは困難であった。

【０００７】一方、カテーテル等の医療用高分子材料として一般にシリコーンが用いられているが生体内に長期

埋入した場合、その周囲にできる線維性カプセルに若く臨床上の問題やさらには生体内脂質により分解するといった問題が最近クローズアップされ、長期埋入材料としては利用されなくなりつつある。透析会誌２６（１）：４３～４７、１９９３に記載されるように、腹腔内留置カテーテルにおいてもシリコーンが用いられているが長期使用において、ＣＡＰＤ歴５年でカテーテルに白色隆起が認められたり、ピンホールが生じ液漏れがみられる等の質的形態的変化が起こる問題が指摘されている。

【０００８】フッ素樹脂は耐薬品性、耐溶剤性、耐油性に優れた材料で生体に埋入した場合、長期安定を示し分解が少ない。さらに熱可塑性フッ素エラストマーは常温ではゴム弾性を示すが一般の熱可塑性樹脂と同様に成形加工できるといった特徴を持ち医療用高分子として利用が期待される。しかし、耐応力破壊性、高温特性を向上させるため放射線による架橋を行う必要がある。この放射線による架橋はその組成からＨＦ（フッ化水素）の脱離による２重結合の生成を利用して行っている。このため生成したＨＦが熱可塑性フッ素エラストマー中に残留し医療用具として用いる場合、安全性および生体への影響が問題となる。

【０００９】

【発明が解決しようとする課題】本発明の目的は、フッ素エラストマー等の生体適合性に優れる部材で構成される腹腔内留置カテーテル、特に、熱可塑性フッ素エラストマーよりなるカテーテルを放射線架橋した際にエラストマー中に残留するＨＦを除去し安全性が高く生体適合性に優れ、長期間の使用が可能な腹腔内留置カテーテルを提供することにある。

【００１０】

【課題を解決するための手段】上記課題は、放射線架橋された熱可塑性フッ素エラストマーを以下の様に洗浄し、素材中の残留物を除去させることにより解決される。

【００１１】放射線架橋を行った熱可塑性フッ素エラストマーを真空加熱を行いかつ、または水－有機溶媒混合溶媒で洗浄しかつ、または熱水処理をする。具体的には脱酸素下でのγ線照射による架橋好ましくは０．５～５Ｍｒａｄで架橋を行った熱可塑性フッ素エラストマーを混合比９５／５～５／９５で、５～３０倍量の水－有機溶媒混合溶媒で５０～１００℃、３０分～４時間還流を行い混合溶媒で数回洗浄し真空乾燥を行った後、５～２０倍量の水で５０～１３０℃、１０分～２時間オートクレーブ処理を行う。この一連の操作を１回または複数回行う。

【００１２】ここで用いる有機溶媒はアセトニトリル、アセトン、テトラヒドロフラン、ジオキサン、ジメチルスルホキシド、エタノールが好ましい。

【００１３】本発明のカテーテルは、少なくともその生体と接する部分が以下で説明するように生体適合性に優れるよう処理されているものであればよく、その形状や構造を問わない。本発明のカテーテルは好ましくはゴム弾性を有するフッ素樹脂であるフッ素エラストマー、特には、熱可塑性フッ素エラストマーでカテーテル本体が形成される。熱可塑性フッ素エラストマーは、熱可塑性フッ素樹脂とも呼ばれ、ふっ素を含む熱可塑性樹脂に弾性を付与するよう開発されたものであり、熱可塑性樹脂で射出成形、押出成形など生産能率のよい成形法によって製品がつくられる。具体的には、商品名ダイエルサーモプラスチック（ダイキン工業（株）社製）等が挙げられる。本発明は熱可塑性フッ素エラストマーを用いて後述する形状のまたはその他の公知の形状のカテーテルを成形する。その後、耐応力破壊性、高温特性を向上させるため放射線を照射して架橋を行う。架橋は、不活性雰囲気下または真空下等の脱酸素化で照射量０．５～５Ｍｒａｄで放射線を照射する。この照射によりＨＦが脱離し２重結合が生成し耐応力破壊性、高温特性が向上する。ところが脱離したＨＦがエラストマー中に残留することになる。本発明では以下の処理を単独または組み合わせて１回または複数回行ってエラストマー中に生成したＨＦを除去する。

【００１４】１）真空加熱

真空度１～７６ｃｍＨｇの真空下で、４０～１５０℃で３０分～４時間カテーテルを処理する。この範囲の条件で処理すると、洗浄溶剤を用いずにある程度の脱ＨＦが可能となる。また、真空加熱に続いてさらに洗浄工程を行うと工程、時間が短縮できる。工程を組み合わせるときは、始めに真空加熱を行うのが好ましい。

【００１５】２）熱水処理

カテーテルを５０～１００℃の熱水で、１０分～２時間処理する。この時、水量は熱可塑性フッ素エラストマー重量の５～２０倍量用いるのが好ましい。熱水処理は熱水に浸漬して行うが、撹拌、等を行ってもよい。工程を組み合わせるときは、水－有機溶媒混合溶媒で洗浄する工程の前に行うと続く水－有機溶媒混合溶媒で洗浄する工程が効率よく行える。

【００１６】３）水－有機溶媒混合溶媒で洗浄する。

用いる有機溶媒は、アセトニトリル、アセトン、テトラヒドロフラン、ジオキサン、ジメチルスルホキシド、エタノール、またはこれらの混合物が好ましい。水と有機溶媒の混合比は、９５／５～５／９５であるのが好ましい。この水－有機溶媒混合溶媒は、熱可塑性フッ素エラストマーの重量の５～３０倍量用いるのが好ましい。それは水－有機溶媒混合溶媒により熱可塑性フッ素エラストマーを膨潤させＨＦを除去できるからである。この工程の後に熱水処理を行うと有機溶媒を除去することができる。水－有機溶媒混合溶媒での洗浄温度は５０～１００℃、洗浄時間は３０分～４時間であるのが好ましい。洗浄は混合溶媒中にカテーテルを浸漬したり、超音波洗浄したり、機械的撹拌、ジェット噴流として吹きつける

等の処理を行うのが好ましい。

【００１７】以上で説明した１）真空加熱、２）熱水処理、３）水－有機溶媒混合溶媒で洗浄の処理は、以下のように組み合わせて行うのが好ましい。この組み合わせを１回として、１～３０回行うのが好ましい。

１）真空加熱、

１）真空加熱＋３）水－有機溶媒混合溶媒で洗浄と２）熱水処理との組み合わせを複数回、

１）真空加熱＋２）熱水処理、１）真空加熱＋２）熱水処理を複数回、

１）真空加熱＋２）熱水処理＋３）水－有機溶媒混合溶媒で洗浄＋２）熱水処理、

１）真空加熱＋２）熱水処理を複数回＋３）水－有機溶媒混合溶媒で洗浄＋２）熱水処理、

１）真空加熱＋２）熱水処理＋３）水－有機溶媒混合溶媒で洗浄と２）熱水処理との組み合わせを複数回、

１）真空加熱＋２）熱水処理を複数回＋３）水－有機溶媒混合溶媒で洗浄と２）熱水処理との組み合わせを複数回、

１）真空加熱＋３）水－有機溶媒混合溶媒で洗浄、

これらの組み合わせ処理で始めの１）真空加熱処理を行わないもの。

【００１８】以下、添付図面を参照して、本発明の好適例に係る腹腔内留置カテーテルを具体的に説明する。図１は本発明の好適な１例を示す腹腔内留置カテーテルの全体側面図であり、図２は、図１におけるＡ－Ａ線断面図である。

【００１９】本発明の腹腔内留置カテーテル１は、腹膜透析法において、透析液を腹腔内に注入し、一定時間経過した後に透析液の排液を腹腔外に排出するといった手技を行う際、その透析液の交換流路として用いられる。すなわち、この腹腔内留置カテーテル１の先端部を患者の腹腔内に腹壁を貫通させて挿入し、この腹腔内留置カテーテル１の先端部を腹腔内に留置すると共に、腹腔内留置カテーテル１の基端部を腹壁外に延出させた状態を維持しながら患者は日常生活を営み、一定時間毎にこの腹腔内留置カテーテル１を介して透析液を交換するものである。

【００２０】この腹腔内留置カテーテル１は、腹腔内に留置される留置部２と、腹壁外に延出される延出部４と、留置部２と延出部４の間の中間部３とからなるカテーテル本体１０と、カテーテル本体１０に設けられた通路１１とを有し、少なくともその生体と接する部分が生体適合性に優れるよう処理されている。

【００２１】カテーテル本体１０は、管状体であって、腹腔内に挿入される先端側は留置部２となっており、腹壁外に延出される基端側は延出部４となっている。また、留置部２と延出部４の間は、中間部３となっている。そして、中間部３は、カテーテル本体１０の通路によって、腹腔内と腹壁外との間に皮下トンネルを形成する。

【００２２】そして、留置部２の先端には、カテーテル本体１０の軸方向に向けて通路１１の開口２１が形成されており、また、留置部２の外表面に軸方向に沿った溝２３と、溝２３の底部に穿設された側孔２２を有している。この側孔２２は、図２に示すように、横断面図において、周方向に等間隔で４つ設けられており、カテーテル本体１０の軸に平行な直線上に等間隔で配設されている。透析液は、開口２１と複数の側孔２２を介して交換される。

【００２３】また、溝２３の形成によって、溝２３と溝２３との間は厚肉となり、凸部９が形成される。このように形成してなる複数の凸部９は、腹腔内壁との接触する面積が広くなるため、腹腔内壁と接触したときに与える圧力が分散され、体内に与える影響が少ない。また、凸部９の先端９２は、留置部２の先端から突出しており、その先端９２は円弧状に形成されており、腹腔内壁やダグラス窩に接触して、傷付けないような形状となっている。この先端９２が設けられていることによって、腹腔内の最も低い所に位置するダグラス窩に留置部２が接触したときに通路（以下、「内腔」ともいう。）１１の開口２１が閉塞されずに確保される。

【００２４】なお、このような厚肉、幅広の凸部９を形成する方法としては、例えば、押し出し成形により厚肉の管体を形成し、その後に外表面を削って溝２３を形成する方法や、押し出し成形時に、凸部９を形成するダイを用いる方法などがある。押し出し成形時に、凸部９を形成するダイを用いる方法により、凸部９を形成する場合には、全長に渡って凸部９が形成されたチューブを成形した後に、所定の長さだけ凸部９の形成によりできた溝２３を埋没させるか、あるいは所定の長さだけ凸部９を削り取る方法がある。また、いずれの方法により凸部９を形成した場合でも、所定間隔で溝２３を埋めて形成された連結部９１を設けて、隣接する凸部９をつなげることにより、強度の向上を図ることができる。

【００２５】また、留置部２（あるいは留置部２の先端）を独立して形成し、中間部３および延出部４と連結させてもよいが、留置部２、中間部３および延長部４を一体的にカテーテル本体１０として形成してもよい。

【００２６】一方、延出部４の基端には、コネクタ（図示せず）等が設けられており、このコネクタ等を介して、透析液バッグや排液バッグ等をチューブで接続してなる腹膜透析システムなどが接続される。

【００２７】中間部（以下、「皮下トンネル部」ともいう。）３は、ループ状に湾曲して形成されており、Ｕ字形状（スワンネック形状）をなしている。そして、皮下トンネル部３の留置部２側には第１のカフ６が、ループ頂点付近には第２のカフ７がそれぞれシリコーン系接着剤等により固定されている。

【００２８】そして、第１のカフ６および第２のカフ７

は、ダクロン製不織布により管状に形成され、このカフ６，７を生体組織に結合固定することにより、生体組織である線維芽細胞がカフ６，７内に増殖して、カテーテル本体１０は一定の位置に留置される。

【００２９】また、カテーテル本体１０の少なくとも留置部２には、Ｘ線不透過材料よりなるマーカー１２を埋設または内外表面に付着しておくことが好ましい。これにより、カテーテル移植時に、Ｘ線透視下においてカテーテル本体１０の位置を確認することができる。このマーカー１２の形状は、図示のように線状として留置部２から皮下トンネル部３に渡って設けてもよく、カテーテル本体１０の全長に渡って設けてもよい。さらには、留置部２から皮下トンネル部３にかけて所定の位置に点在させて設けてもよい。マーカー１２を構成するＸ線不透過材料としては、例えば、タングステン、硫酸バリウム、金、白金、あるいはそれらの合金、等が挙げられる。

【００３０】また、カテーテル本体１０の内腔１１には、少なくとも留置部２から皮下トンネル部３に渡って、複数のフィンを設けることにより、腹腔内や腹壁内でカテーテル移植時や透析液の交換時に腹壁内や腹腔内で内腔１１が潰れて閉塞することを防止することが可能である。

【００３１】ここで、カテーテル本体１０の全長は、症例によって異なるが、２５０～６００mm程度、好ましくは３００～５５０mm程度、より好ましくは３５０～５００mm程度であり、このうち留置部２は、１５０～２００mm程度であり、皮下トンネル部３は、１００～１５０mm程度であり、延出部４は、１００～１５０mm程度であることが好ましい。さらに、留置部２の凸部９形成部は、１１０～６０mm程度であり、第１および第２のカフ６，７は、５．０～１５mm程度であることが好ましい。また、凸部の先端９２の突出長は、１．０～２０mm程度、好ましくは２．０～１０mm程度である。

【００３２】そして、カテーテル本体１０の内径は、１．０～３．５mm程度、好ましくは２．０～３．０mm程度であり、カテーテル本体１０の肉厚は、留置部２のみあるいは留置部２の凸部９形成部のみを厚肉に形成してもよく、全長に渡って同じ肉厚でもよいが、具体的には、厚肉な部分において１．０～３．０mm程度、好ましくは２．０～２．５mm程度である。そして、留置部２に形成された凸部９の高さ（溝２３の深さ）は、０．５～１．５mm程度、好ましくは１．０～１．３mm程度である。

【００３３】また、凸部９あるいは溝２３の数は、４つに限らず、１つから３つまたは５つ以上であってもよく、カテーテル本体１０の外径等にあわせて決められ、凸部９の数に応じて凸部９の高さを設定することが好ましい。さらに、連結部９１は、カテーテル本体１０を形成する材質、肉厚等により、必要に応じて設ければよい。また、側孔２２の数は、溝２３の数にもよるが溝２３の数１つあたり、６～２０個程度、好ましくは８～１６個程度である。

【００３４】以上説明した腹腔内留置カテーテル１の少なくとも留置部２から皮下トンネル部３に渡って、少なくとも外表面に親水化処理を施すことが好ましく、このような親水化処理として、例えば、ポリ（２－ヒドロキシエチルメタクリレート）、ポリヒドロキシエチルアクリレート、ヒドロキシプロピルセルロース、メチルビニルエーテル無水マレイン酸共重合体、ポリエチレングリコール、ポリアクリルアミド、ポリビニルピロリドン、等の親水性ポリマーをコーティングする方法が挙げられる。

【００３５】このような処理を施した場合には、カテーテルを腹腔内へ挿入するときの挿入抵抗を軽減することができ、カテーテル移植手術の時間が短縮されるので、患者にカテーテルを移植する際に患者の負担が低減される。また、粘膜の損傷をより少なくし、組織癒着の抑制効果もある。

【００３６】次に、本発明の好適実施例に係る腹腔内留置カテーテル１を患者に移植したときの状態について具体的に説明する。なお、図３は、本発明の実施例に係る腹腔内留置カテーテルを患者の腹壁に移植した状態を示す部分断面図である。

【００３７】腹腔内留置カテーテル１の皮下トンネル部３は、図３に示すように、腹壁１００を貫通して移植されており、カテーテル本体１０の内腔１１により腹腔内１２０と腹壁外１１０との間に皮下トンネルを形成している。この皮下トンネルを介して、透析液が交換される。また、ループ状に湾曲して形成された皮下トンネル部３の先端側は、腹膜１０１を貫通して腹腔内１２０に留置されており、皮下トンネル部３の基端側は、表皮１０５を貫通して腹壁外１１０に延出されている。そして、腹腔内１２０に留置された留置部２の先端は、ダグラス窩に位置され、また、腹壁外１１０に延出された延出部４の基端にはコネクタが接続される。

【００３８】皮下トンネル部３の留置部２側に設けられた第１のカフ６は、筋層組織１０２の底部に位置され、腹膜１０１に結合固定されている。この第１のカフ６により、カテーテル本体１０が腹壁１００に固定され、留置部２が一定の位置に留置される。また、この第１のカフ６は、腹腔１２０に透析液を注入したときに透析液が腹腔１２０外に漏出することを防止する。

【００３９】皮下トンネル部３のループ頂点付近に設けられた第２のカフ７は、皮下組織１０４の底部に位置され、腹直筋筋膜１０３に結合固定されている。この第２のカフ７により、透析液注入・排出口を下向きにして、皮下トンネル部３が生体組織に固定される。

【００４０】

【実施例】以下、本発明を実施例によりさらに具体的に説明する。

【００４１】（実施例１）図１に示す生体適合性に優れた熱可塑性フッ素エラストマーをカテーテル素材として用いた腹膜灌流透析カテーテルを用いた。カテーテルの全長は４３５ｍｍ、内径２．５ｍｍ、外径４．７ｍｍの管状体であり、その管状体の肉厚の長軸方向にＸ線不透過のラインが内包されている。基端の一方は腹腔内に留置されその先端部分８５ｍｍの側面には長軸方向に沿って４つの溝を形成した。さらにこの溝内に直径０．５ｍｍの注排液孔が所定の間隔をおいて穿設されている。腹腔部の基部におけるカテーテルの外周には幅１ｃｍのダクロン不織布よりなる第１のカフが設けられカテーテルが固定される。さらに第１カフよりカテーテル中間部方向に皮下トンネル部を設け腹直筋筋膜にカテーテルが固定されるようにカテーテルの外周に幅１ｃｍのダクロン不織布よりのなる第２のカフが設けられカテーテルの他方の基端が体外に延出される。ここで生体適合性を向上させるためのカテーテル素材中の残留物の除去方法について説明する。熱可塑性フッ素エラストマー（ダイキン工業（株）製、ダイエルサーモプラスチックＴ－５３０）より成るカテーテルを脱酸素下でγ線３Ｍｒａｄ照射し架橋を行った後、２０倍量のアセトニトリル－水１：１よりなる混合溶媒中で７０℃、４時間還流し、真空乾燥を行った。さらに６７ｍｌの蒸留水で１２１℃、６０分オートクレーブ処理（ＡＣ抽出）を行った。この４時間混合溶媒中で還流し真空乾燥後ＡＣ抽出する操作を１回の操作とし表１に示す回数をそれぞれ、計１３回行った。

【００４２】（比較例１）熱可塑性フッ素エラストマー（ダイキン工業（株）製、ダイエルサーモプラスチックＴ－５３０）を２４０℃にて厚さ０．２ｍｍのシートを作製した。

【００４３】（比較例２）熱可塑性フッ素エラストマー（ダイキン工業（株）製、ダイエルサーモプラスチックＴ－５３０）を２４０℃にて厚さ０．２ｍｍのシートを作製し、脱酸素下γ線３Ｍｒａｄ照射した。

【００４４】（比較例３）シリコーンエラストマー（ダウコーニング社製　サイラスティックＱ７－４７５０）を１１０℃にて厚さ０．２ｍｍのシートを作製した。

【００４５】評価試験１

実施例１および比較例で得られた各回数毎のオートクレーブ抽出液についてフッ化物イオン濃度をランタンーアリザリンコンプレキソン吸光光度法により測定し、ＨＦの定量を行った。結果を表１に示す。

【００４６】表１に示す結果から明らかなように、未架橋のものとγ線架橋を行ったものとを比較するとγ線架橋を行ったものは多量のＨＦが生成しているのがわかる。本発明の洗浄方法に係わる実施例１によって得られた架橋熱可塑性エラストマーは、洗浄回数が増す毎にＨＦの溶出が減少しており洗浄回数１３回において未架橋のものと同レベルとなった。

【００４７】評価試験２

実施例１によってＨＦの溶出量が未架橋のものと同レベルとなった架橋熱可塑性フッ素エラストマーおよび比較例１、比較例２、比較例３で得られたサンプルφ１０ｍｍ、厚さ０．２ｍｍ片をマウス腹腔内に埋入し、１２週間後の周辺組織の変化について病理組織学的に検索した。結果を表２に示す。比較例３では激しい腹膜炎が誘発されていた。比較例１では腹膜炎こそ示されないが、サンプル周囲に線維性被膜（カプセル）形成が認められかつ、炎症の指標となるHistiocyte浸潤が伴っていた。比較例２では同様なカプセル形成とHistiocyte浸潤が比較例１より高度に認められた。それらに比し、実施例１では腹膜炎やサンプル周囲の線維性被膜形成やHistiocyte浸潤が誘発されないばかりか腹腔内諸臓器表面を被覆している中皮細胞様の細胞に被覆されており、その材料の生体適合性の高さが強く示唆された。

【００４８】評価試験３

熱可塑性フッ素エラストマーの放射線架橋による耐応力破壊性および高温特性の向上について示す。

【００４９】内径φ２．５ｍｍ、外径φ４．７ｍｍの熱可塑性フッ素エラストマー、γ線３Ｍｒａｄ照射熱可塑性フッ素エラストマーおよびシリコーンのチューブを３０°に湾曲し、その状態で５０℃のイソジン溶液に浸漬した。浸漬５０日目、シリコーンチューブはイソジンによりチューブは不透明となりさらに一部チューブ表面に隆起物が見られた。これに対し、γ線照射熱可塑性フッ素エラストマーは透明性が維持されておりこの素材の耐薬剤性が示された。また、γ線未照射のものについては浸漬１日目にチューブの切断が見られたが、γ線３Ｍｒａｄ照射のチューブについては切断および亀裂等は見られずγ線照射による耐応力破壊性、加温時の物性の向上が確認された。

【００５０】

表　１

	フッ化物イオン濃度（ｐｐｍ）		
	比較例１	比較例２	実施例１
ＡＣ抽出	０．０８	５．５５	

4hr洗浄後AC抽出× 1	1．88
4hr洗浄後AC抽出× 3	0．65
4hr洗浄後AC抽出× 5	0．33
4hr洗浄後AC抽出× 7	0．25
4hr洗浄後AC抽出× 9	0．15
4hr洗浄後AC抽出×11	0．10
4hr洗浄後AC抽出×13	0．08

【0051】（実施例2）真空度76cmHgで、120℃、2時間、真空加熱した後、実施例1と同様の処理を行ったところ、実施例1に比べて少ない洗浄回数、時間で同様の効果が得られることがわかった。

【0052】

表 2

	腹膜炎SCORE	サンプル周囲のカプセル形成	サンプルに付着または浸潤している細胞
実施例1	−	−	中皮細胞（+）
比較例1	−	+	Histiocyte（+）
比較例2	−	++	Histiocyte（++）
比較例3	+++	−	Histiocyte（+）

【0053】

【発明の効果】以上説明した様に本発明により薬剤等による劣化が少なく、また放射線架橋による耐応力破壊性、高温特性の向上、さらに洗浄を行ったことにより生体適合性が向上した腹腔内留置カテーテルが得られる。

【図面の簡単な説明】

【図1】 本発明の実施例に係る腹腔内留置カテーテルの全体側面図。

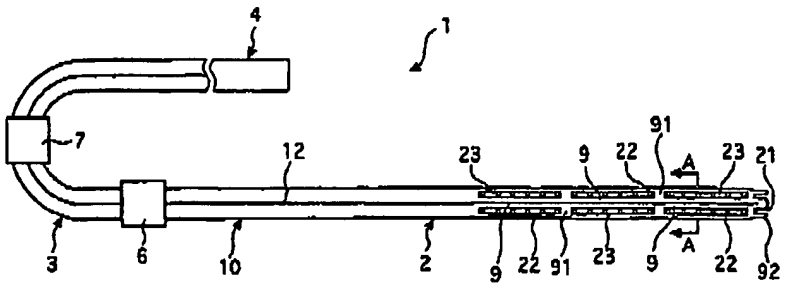
【図2】 図1におけるA－A線断面図。

【図3】 本発明の実施例に係る腹腔内留置カテーテルを患者の腹壁に移植した状態を示す部分断面図。

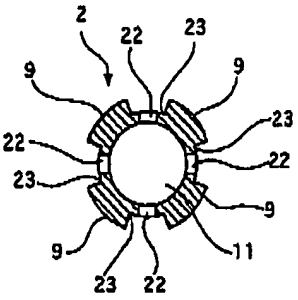
【符号の説明】

1 腹腔内留置カテーテル
2 留置部
3 皮下トンネル部
4 延出部
6 第1のカフ
7 第2のカフ
9 凸部
10 カテーテル本体
11 通路
12 マーカー
21 開口
22 側孔
23 溝
91 連結部
92 凸部の先端
100 腹壁
101 腹膜
102 筋層組織
103 腹直筋筋膜
104 皮下組織
110 腹壁外
120 腹腔
150 ダウングロース

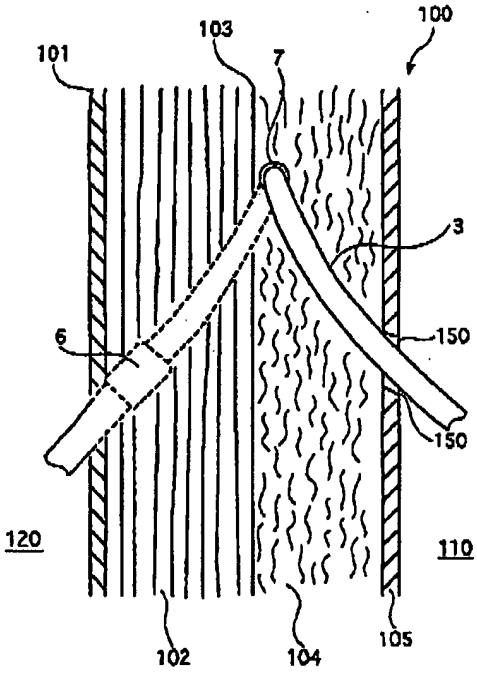
【図1】



【図2】



【図3】



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